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THE AMERICAN COUNCIL OF LEARNED SOCIETIES

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TRADITION AND DISCOVERY

ROBERT OPPENHEIMER

The ACLS Annual Lecture, delivered in connection with the Annual Meeting at the University of Rochester, Rochester, New York, on January 22, 1959.

When Columbus set sail on his first voyage of discovery, the evening of the first day he opened the page of what would later be the log of this voyage: on it he wrote, "Jesus cum Maria sit nobis in via." Partly this was the terror of the voyage; but partly also it was some foreknowledge of the irreversible change that this *via* would make in human history, a change comparable to, perhaps greater than, the enrichment of European culture by the renewal and refreshment of the classic traditions.

In this middle of the Twentieth Century it has occurred to many that we are not in so dissimilar a fix: the sense of a voyage into a very unknown future, the sense of a tradition qualifying all our future but not exhausting it, the sense that in this immense, almost thunderous impact of discovery upon tradition, we have come to a new phase of human history.

Terror attaches to new knowledge, and the unmooring, the unpreparedness that men have to deal with it. You may think of the two legends, of the story of the Tree of Knowledge, of the legend of Prometheus, which, though they are from different cultures and are different stories, have in common that they attest that when man gets too smart he gets into trouble. Indeed, even things which are not practical discoveries—not the discovery of America, or of fire—but are quite abstract, come with a sense of terror. I have found that among my colleagues in the sciences, when people know that they are making some deep finding, not a finding which has any threat in it to the security or comfort of man but some new insight into the order of the natural world, they measure its depth by the fear that comes over them. Niels Bohr once said to me, "When I am up to something important, I am touched with the thought of suicide."

This question of what discovery does to tradition and tradition for discovery, some parts of which I am to talk about tonight, of course touches on an ancient and inexhaustible theme: the struggle, the balance, and the lack of balance between the familiar and essentially timeless in human life, and the always manifest sense of change. Of tradition, I need not say what we mean by that word in a lecture under the auspices of a society of learned folk, whose whole effort is to preserve,

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to refresh, to transmit, and to increase our insight into what men have done as men, in their art, their learning, their poetry, their politics, their science, their philosophy. Tradition is no less than what makes it possible for us to deal as sentient and thinking beings with our experiences, to cope with our sorrows, to limit and ennoble our joys, to understand what happens to us, to talk to one another, to relate one thing to another, to find the themes which organize experience and give it meaning, to see the relevance of one thing to another. It is of course what makes us human, and what makes us civil. It is typically and decisively the common heritage, that which men do not have to explain to each other; that which in happier days they did explain to their children; that which they can rely on as being present, each in the other's head and heart. It has as such an assimilating quality; it points to the likenesses of things; it points to the connection of things; and of course it has also an oversimplifying quality, since things in fact really are not very alike. It finds the great human themes which run through everything, which we can come back to, which we can recognize, which we can communicate. This communication is often verbal, but it does not have to be.

In very primitive societies, as the anthropologists at least have told us about them, one even finds instances in which the meaning of tradition is to prevent any essential novelty, to assimilate one life to another, one generation to another, one season's cycle to another, so that everything has a place, so that everything is familiar. It has today a very different function. In the sense in which I shall be using the word, in a sense which is relevant to our time, tradition is also the matrix which makes discovery, in an important sense, possible. It is the organ of interpretation, of enrichment and understanding that, in the arts, and in the sciences, and even in our common ethical life, gives meaning to new discovery. It is of course the special mark, the "cachet spécifique", of the modern European tradition that it has catalyzed, for reasons that no one has really been quite clever enough to understand, an immense outpouring and an immense growth of discovery unlike anything which man has known, an unprecedented use of the past for the future; an unprecedented enrichment of the power to find new things by virtue of the extent to which we were in control of the old: unprecedented in volume, in weight, in wealth, in scope, and unprecedented in many ways in quality also, even if one thinks of the highest days of ancient cultures.

This discovery and this use of it is not precisely like the discovery of America; there is more of the element of invention and creation in it than in the discovery of America. There was, God knows, dedication, almost fanaticism, courage and high skill in the discovery of America; but to an extent that is misleading, if we think of the contemporary world, America was really there; it was not in any sense an artifact

of Columbus or of his time or of his voyage. If you think of some of the things which enrich the present time: atonality in music, or the structure of the genetic material which gives to all living things the qualities of life, or such a notion as parity, which has been prominent in discoveries in basic physics, these are not things which were quite so simply given and there to be found, simply, by anyone. It required a tradition, a culture, a background, even to come to these things, even to define them, even to know the means by which they can be found. It depends on where you are, what you are, how you talk; and the element of invention, the element of creation is very great in these. I need not talk about space travel; but it is worth noting that even in the primitive efforts so far, which will soon be much less primitive, to see how things are away from this earth, the one startling thing that has been found is something which would have been completely impossible for Columbus to have understood, or to have detected, though he might have died of it: a very intense zone of radiation whose presence was not expected. This is the kind of discovery that rests on an existing special tradition, in that we are used to looking for this order of experience; we know a great deal about the properties of the world, and did not simply send a piece of material up there, but sent up instruments which are themselves the outgrowths of centuries of study and of specialized skill.

I am not laboring this point because I want to argue either side of the ontological question, "Are the things which are discovered *there*, or are they improvised or invented?" I regard this as rather an empty question. Of course they are there, or they could not be discovered; but their discovery depends on an elaborate development of the human tradition without which they could not be discovered; and their discovery reminds us—and to this I must return later—that in the world there are countless wonders waiting to be discovered, were there in the human tradition the appropriate sophistication, the appropriate development. Discovery is neither wholly necessary, nor wholly free. We are not free to discover what is not there; and what is there is by no means necessarily discovered.

I think that it will add a little to the candor and clarity of what I have to say if I talk for a few minutes about the developments in this century in my own science, because, although I do not propose to lecture about them, and although I am convinced that the story I have to tell you is a story which does not depend for its telling on my having been a physicist, the way I tell it will be affected by that, and by one special episode in it; and perhaps rather than warn you at the end, I should warn you at the beginning, that there is a *parti pris*; there is an attitude in me which comes from the time of human history I have lived, from the kind of work I have seen and done and which, much as I might hope to persuade you to share it, you may not be free or able to share.

It has been a great half century of discovery in physics. Even if we leave out the subjects near physics, like cosmology, astrophysics, the wonders of biochemistry, even if we leave out practical things like nuclear power, just in the fundamental physics relating to our ideas of space, time, cause and matter, there have been very profound changes, which, for those who have been blessed to live through them, have constituted an experience of deep wonder and excitement. The first of these was of course relativity, which started with the recognition that communication could not be instantaneous, that there was no such thing as an infinite velocity; and that, as a logical consequence, judgments of simultaneity, of rates of clocks, and of distances would not appear the same to two observers moving with respect to each other. The logical outgrowth of this was the set of theories of relativity which are associated with Einstein's name.

The second great development is the one that I would like to come back to, the discovery and the understanding of what is called the quantum, the quantum of action, and its meaning. Its most primitive meaning is that, although in practical life, in large scale affairs, we can legitimately think of an idealization, that idealization is not valid in the atomic domains. In ordinary experience, we can find out about a system—a physical system—without concern in principle about the way we enquire, which leaves the object that is being studied undisturbed, unconnected with us as observers. Thus the effects of an observation can be regarded as arbitrarily weak. This idealization is not valid in the atomic domain: there is a limit to the weakness of observation; and therefore the conditions of observation enter in a radical way into the kind of description that we must use for an atomic system. That is the root cause, and the quantum of action is itself simply the measure, of this granular or wholistic quality of observation. It is the barrier below which we cannot go in the gentleness with which we observe the system; and this barrier is itself the reason why, in the atomic domain, one cannot have a legitimate idealization of physical matter, as possessed of those properties which ordinary large scale matter has, and why there is a logical contradiction in assuming, for instance, an object at a given place and moving with a certain speed—a logical contradiction in supposing that such an object can exist. I shall come back to why that has an effect on one's general outlook.

There have been other discoveries, some made, some in the making, some yet to be made, that probably will touch as deeply our notions of objectifiability and causality as these. One, for instance, has to do with the ancient theme of atoms. It has become very clear that there are in the world of nature no immutable atoms; that if there are immutable things—and there are—these are very abstract entities and structures, characterizing constellations of atoms; the changelessness which the philosophical atomists saw in the atoms themselves attaches not to

the objects but to much more abstract quantities, which one is only beginning to sort out. We have at this time the feeling that we are wandering around in fog, somewhere near base camp number 1, for another great ascent, for a change in our view of matter, space and time, which we hope we may live to see, which is clearly in the making, because of the critical contradictions in our knowledge as it is today.

These things, when I talk about them, may sound as though they should be intelligible and I do not believe they can be made honestly and deeply intelligible short of hard study, because they are not about ordinary experience, and they are not legitimately put in the vague words which I have used. I believe in trying, as I have tried, and will advocate that other people try, to explain them as well as possible; but I think that we must be aware of the fact that these are highly technical things, with their roots in a highly developed and very beautiful but by no means young tradition, and that we cannot short circuit that. To that I may return.

The point about atomic theory, quantum theory, is that we have made, largely because of the philosophic interest and insight of Niels Bohr, a parable of it, which is called "complementarity". I spoke of the fact that in atomic situations, one cannot make observation infinitely gentle; and that therefore one cannot logically attribute to objects on an atomic scale the full range of properties which are familiar in baseballs and planets, in Newtonian mechanics and all the rest of large scale science.

The point now is that one can attribute some of these properties in a given context, and others in another context; the context is determined by the experimental arrangement, by the nature of the measuring equipment; the two contexts are not realizable in any single arrangement, and are called complementary. Such are, for instance, the context in which one may endeavour to find out where something is, and find indeed that it is localizable; and the other context in which one may make another kind of study, and find out what is the color of the wave associated with this object, and thus its momentum. One will not be able to find an experiment that reconciles these two, and which gives both pieces of information; one calls them complementary approaches to the study of the atomic system.

This indicates, in a way which is quite rigorous, that there is a place for many approaches to the study of a system, none of which completely exhausts the subject. You need to think of more than one approach, and you need to carry it out, in order to find out everything that you can find out. But if you do one, you lose the value of having done the other; you are doing a new study; you cannot apply what you have found in one experiment to a situation in which you set up another. Each is a whole chapter; and these chapters are not serial or cumulative; they have an individual quality, each of which partly erases what

came before. One sees in this a very strong and useful analogy to the role of tradition in the varying cultures, in providing complementary bases for the organization of human experience. One cannot combine a primitive culture such as that of the Pueblo Indians, with a culture such as that of contemporary Japan, and have anything meaningful left. Yet it is clear that there are elements in the life of the Pueblo Indians which are lost in the life of the Japanese, and elements in the life of the Japanese which are completely unobtainable and unavailable to the life of the Pueblos. One is therefore prepared to find that the place and style and role of culture, of tradition, of our history, and of our role as observers does affect the nature of our discoveries and the nature of the organization of the world, and yet not to be misled by this to any view which would deprecate the objectivity, or, in the fancy philosophical word, the validity, of the discoveries that are made. This is perhaps helpful in coping with the immense problem of the impact of discovery on tradition.

I want to talk tonight about some of the consequences of this impact; some of the consequences of the growth of science. As I have said, I cannot help having my own science in mind, but I am thinking in terms of science as the word was used a few centuries ago, the sciences of man and of history as well as the sciences of nature. I would be very glad if I could talk to you about what has been happening and what seems likely to keep on happening, and to make it as serious as I think it really is, and then come up and present a course of action, a sort of therapy; but I am not in a position to do that. I do not have a complete therapy; and the suggestions I have are almost in the nature of footnotes. They are important, but they leave most unsaid. I regard our situation as grave, interesting, and radically novel, something which people have not quite had to face in man's history. It will put difficult choices to us; it is doing so today; and we can be judged, we will be judged, by our response. We can be judged by both in our conduct here, in what we make of this country of ours, and by the sort of example we set for the larger world, in which increasingly the troubles and the glories of which I must speak will become a larger part of the landscape.

It seems to me important that we know what it is that is happening, what it is that has struck us, and that we come with open eyes to face it. I think it may be not only that I do not have a cure, but that there is not a cure; that what is called for is a deep, rich acceptance.

Because science rests on, intersects with, alters, affects almost all of man's ethical life, the change in the world which its growth has made, both material and intellectual, is an unfathomably great one. I do not propose to talk about the material changes—they are too familiar to you—they are not unimportant. On the intellectual side I want to talk about three traits. One is the growth itself; one is the question of its structure; and one is a related question, the openness of knowledge—one could

say its potential infiniteness and therefore of course, as far as man is concerned, its inevitable partialness.

It is by no means the first time that there has been such a great change in the intellectual scene. As recently as the Sixteenth Century, when in not much more than a hundred years, the closed, God-ordered world that was inherited from the earlier Renaissance suddenly changed into an open one, almost all man's ideas—that is European man's ideas—the deep organizing ones about essence and final cause in nature and in the knowledge of nature, were changed. And a little later John Donne was to write of it, "Tis all in pieces, all cohaerence gone/All just supply, and all relation." Still that was a very different situation than we have today.

Two of the features—the third could hardly then have been guessed—two of the features which I want to illustrate and to elaborate a little lie in this: they are both a sort of imbalance. In saying imbalance, clearly, one has a norm of human life in mind; I think that one has in mind some earlier, typically simpler, and usually imaginedly happier time. There is imbalance between tradition, in its meaningful sense, what is intimate, familiar, relatively old and established in human knowledge, things that people have lived with for a long time, the contours and meanings of which they know, things that they know in terms of tradition, their own experience, their schooling; all of that on the one hand, and on the other, what is new and therefore known very superficially, or known in intimacy only to very few people. The other kind of imbalance is a related one. It is the imbalance between what is known to us as a community, what is common knowledge, what we can take for granted with each other, and in each other, what is known by man; and on the other hand, all the rest, that is known only by small special groups, by specialized communities, people who are interested and dedicated, who are involved in the work of increasing human knowledge and human understanding but are not able to put it into the common knowledge of man, not able to make it something of which we and our neighbors can be sure that we have been through together, not able to make of it something which, rich and beautiful, is the very basis of civilized life.

I am one of those who in many ways think that education has improved, not only quantitatively but qualitatively, over this century that has just passed; but I think that, in spite of this, the center of man's knowledge, the common heritage and talk and world is very much less robust and very much less intimate, very much more vague and second-hand and insubstantial than it was a hundred years ago. Of course the core of our common life is many things: it is feeling, affection, common undertakings, and a way to communicate about them, a way to celebrate them together; but a large part of it is a cognitive core—what we know in common—and this part is not in very good shape.

Because I believe that we are "knowers" among other things, and perhaps even first among other things, because what we know underlies what we value and what we do, I think we need to have this part of our house in better order.

The educational and cultural problem is vaster than it has ever been. In some ways this is trivial. Thus we deal with more people; we hope for more from a larger fraction; and this is one thing that I, myself, am fairly confident will spread, one American dream that is likely to be a practical dream for the whole world. We have ourselves that very loose, unhierarchical character in our society, that de Tocqueville noted. Our society is not ordered in the sense that we can look up its hierarchies in a book; we cannot find out anywhere who is the best composer or the best comic or the best physicist: I think it would be repugnant to us if we could; and when it is tried, as it sometimes is, we laugh at it.

The other side of the story is quite brutal. In the Sixteenth Century, much more even in the Seventeenth, people began to express some anxiety about this trait of the European tradition. They were learning a great deal new, more than they had thought likely, and they thought that within half a century, perhaps a century, as much would be learned as had been known before. This frightened them. Now the sum of human knowledge is not a very clearly defined thing: if you think of the Gospel according to St. Matthew, or Oedipus, you cannot imagine saying that we are doing twice as much as that today; if you think of the Second Inaugural, you cannot think that there is any quantitative way to measure a change, but only some strong way to say how much it has come to mean in our life. But if we are talking of propositional knowledge, of statements that this and that are true, or that something follows from this, or that something is probable, then it is very different. Today, it can hardly be doubted—and I shall qualify this a little, but not much—that every ten years or so we know twice as much of such knowledge as we did ten years earlier. You can measure this in a number of rather stupid ways; but probably one way of measuring it is by volume of publication, because any society will protect itself against the redundant and the trivial. Things that ought not to be published more or less do not get published. Life is hard enough without that. And the physical weight of what is published in the natural sciences, just to take a narrow sample, the physical weight is a perfectly good measure of the growth of knowledge. It confirms this pattern of growth.

Dr. Price, at the Institute for Advanced Study, has made a study of another rather brutal thing, and that is the number of men occupied in the acquisition of knowledge. This is an exponential function of time, with a characteristic time of ten years, that goes back almost two centuries. It cannot go on, because some people will have to grow vegetables, though apparently not very many; some people will have to argue law cases, though I hope not very many; but it will go on, and

the rate of knowledge will increase increasing, though it will not increase increase increase increasing indefinitely. I think you may know the phrase, a very vivid one, that Professor Purcell of Harvard used. He said, "Over ninety percent of all scientists are alive." The results are not all funny. Some of them are very very troublesome.

It make a very new problem, because mature men today—and this is true of all of us, of all my hosts and me and all my hosts' guests—are really necessarily and deeply quite unaware of the greater part of what is known. They did not learn about it in school; they have no immediate practice in it; and it involves a way of talking and a tradition for which they are not prepared, because these too have grown out of what they learned when they last looked in on the subject, since they looked. Sometimes we are suddenly shocked into a recognition that big change has occurred. I think that may have been true of the sudden wartime development of atomic energy; but this is an accident, a mark of punctuation, and not of course in any way an encounter with the problem.

People do hear and read about new knowledge; they hear a little from friends, and over the radio. This would be better if it were more directly rooted in a living and commonly shared tradition; for most of new knowledge is specialized in character, not all equally so. Most new knowledge is something that you can understand with some kind of honest understanding if you know what has gone before, know the terms, for instance know the instruments that are involved, and know the abstract ideas that are involved. It is not something that you are likely to understand if you have spent all your previous life in a normal common-sense life. It involves the application of what was earlier acquired, it involves this tradition, words, experience, mathematics, logic; all these things rest on what went before; and that means that there is a certain danger, rather a grim one, in trying to pick up, without a good deal of skepticism and caution, a synopsis of modern genetics or cosmology just by reading about it. The words may sound familiar; and many of those I used in saying a few words about my own subject I think did sound familiar, like "time" for instance. They may suggest something that one has seen on the playing field or in human affairs. Sometimes that is true; but characteristically and much more often it is not true; the words have the characteristics of a bad pun; they sound the same, but the meaning has been redefined out of all similarity to the common meaning given by common experience.

If you think of the old questions about cosmology—what they meant in the Fifteenth Century and what they mean today—you will notice this. There was then the question, and there is today, of whether the universe is closed or open in space, whether it is closed in time, whether it had a beginning, whether it had an end, or neither one nor the other. These are questions that we are thinking about, and about

which we are learning something, even questions for which a kind of qualified limited answer may well be forthcoming; but these are not the questions that the Fifteenth Century men were asking, the ones we will answer. The words that we use, like "relativity", which I used, or "indeterminate", they do not mean what these words mean in ordinary human life; and I am afraid that if people without study began to get some indication of what they did mean, they would have been defined and refined out of all interest to primitive human curiosity. This will happen too in the sciences of man, and the sciences of life, which are just now taking such enormous steps toward fundamental discovery. When the biologists begin to answer the question, "What is life?" no layman will recognize that this is an answer to the question put as to what life was.

But this means that common sense and specialized knowledge are in a very special, unsymmetric relation to each other. All our knowledge, all our specialized knowledge, starts with common life: words which we know and do not have to argue about, that are in our experience. Then we begin to manipulate, intellectually and physically; and new things grow. I think always of this analogy of the fingers of the hand, separating in accordance with these manipulations, with these differences in technique, according to the plural ways with which one can question nature. What flows back from special knowledge, back into common knowledge, is rather a small part. I am not talking so much about the fact that we use difficult words. I am talking about the fact that behind the difficult words there is a difference in experience, in life and tradition, which is very hard to bridge. Anyone who tries to tell you what goes on in the specialized parts of the world of knowledge—and this is I believe not quite as true of the anthropologist as of the physicist, not quite as true of the philologist as of the biologist, but I think of it as true of everyone—has some of the same problems as a man who has been off to war for five years talking to people who stayed home, or a man who has been in prison; but in addition there is of course the intellectual problem, again varying in difficulty from subject to subject, particularly difficult where the abstractions of an explosively growing mathematics are involved. It is hard intellectual work, but it also involves this sense of remoteness and alienation.

This knowledge is, of course, not without order. It is essentially all about order; its purpose is to discover and create the order which relates things with one another and to reduce, though not quite eliminate, the arbitrary in human experience. Yet it is not orderly in the sense that there are a few general premises from which one can deduce everything else. It is not orderly in the sense that one can say, "But of course I don't really know about the world of nature and man, but I know the basic principles; and I could always pick up the rest", because, in a certain sense, there are no basic principles like that. The deep things in physics, and probably

in mathematics, are not things you can tell about unless you are talking to someone who has lived a long time acquiring the tradition. You can say that the principle of sufficient reason is a basic principle, but it does not get you very far, and I am not all that sure that it is true.

One is faced here with a situation in which the practitioners of the specialized sciences have between them contacts, valuable, important; but there is no total relevance, no total mapping of one on the other; and between all these people — and as of now it is still a very small part of our society — between these and the people who do not live in this world, there is only such communication as is mediated by earlier or later education, by friendship, by patience, and by the best of good will. That is why the core of our cognitive life has this sense of emptiness. It is because we learn of learning as we learn of something remote, not concerning us, going on on a distant frontier; and things that are left to our common life are untouched, unstrengthened and unilluminated by this enormous wonder about the world which is everywhere about us, which could flood us with light, yet which is only faintly, and I think rather sentimentally, perceived.

There is a lot of relation in this world of science. It has structure, and refers to a beautifully ordered world; it is rich; it is always astonishing; it is always different; it is always subtle. There is order so that things cohere, so that general things encompass special ones; and this means in fact that a great deal of what was in textbooks a long time ago does not have to be in them today. It means that there is a kind of sloughing off of knowledge, not because it was not true, but because we can learn a few larger truths from which we shall have more easy access to those which we may now, for the time being, forget. And that process gallops ahead. So, even more rapidly, does the diversification of what was found out, the increase and the strangeness and the variety, so that the balance on the whole is that it is much harder to get an education today, and it probably will be harder ten years from now. Arthur Ryder, my Sanskrit teacher in Berkeley, used to chide me, that if science were any good, it would be much easier to be an educated man than it ever was before. His view was that the world was closed; ours is that it is open.

There is another sense to this kind of unity, and it is important that we be aware of it. No part of science follows really from any other in any usable form. In principle, I suppose nothing happens in chemistry or in biology which is in any kind of contradiction with the laws of physics; but we cannot deduce anything of any interest about a living organism by knowing any amount of physics. It is a different order of nature. Now I think it is a great thing that the great synapses, the barriers which seem to break science down into non-communicating parts, appear about to yield, not in the sense that any science is encompassed by any other, but in the sense that one sees no lack of logical

compatibility, that one has a way of thinking without inconsistency. One sample is just that there have been good suggestions, and a bit of evidence, as to how, following known laws of physics, life could have originated in the state that the earth was in a long time ago. It is not a finished chapter; it has just begun. I do not think that it will go without some hitches; but is not now as though the world of the living and the world of the dead have a cleft between them. One can see how one could, and almost certainly did, grow from the other. You know of the really brilliant progress in understanding how, in living matter, there is information-bearing machinery, particularly in genetic material. We know a little of how it bears information, and something, not much, about how it transmits it. But the whole idea that a necessary cause, an efficient cause, could be consistent with purpose is illuminated by this, so that the characteristic features of life, which are that it has to be described in terms of ends and purposes, are not in conflict with the idea of necessity, the idea of efficient causation, the universal validity of the large and lovely laws of physics. One sees many other examples, perhaps just beginning, that elements of coding are present in the simplest psychic operations of cognition, perception, and recognition. We see really that in the whole of our knowledge of the natural world, including ourselves as natural objects, this whole arch that reaches from the earliest days of history, from the farthest our telescopes and imaginations can see, to the most subtle questions of human behavior, there are no signs of any unmanageable inconsistency. Of course that does not mean, and it never will, that from one part of our knowledge we can learn another. It means only that we will have compatible ways of understanding.

The receptacle of all this knowledge is, of course, not man in general; nor is it quite the individual specialist; rather it is the specialized communities of interlocking expertise, men who may call themselves high energy physicists, or high polymer physicists, or radiobiologists. It comes to these groups of people who have very warm close professional relations, even if they do not know each other as friends, even if, alas, they are kept apart. We know each other; and we have this, to my mind, really remarkable characteristic, that we are grateful to each other for getting things straightened out. It is the hallmark of science in its largest sense that in it one finds this immediate and pervasive gratitude to others, who are smarter than we were. We notice this intimacy, this cordiality and warmth, notice it with great hope, and then sometimes with melancholy, partly because it does not in any real sense encompass the world; but even more when we think of its holding the world together, for the bonds really do not seem strong enough for that, for the times we live in. What we have is a modern version of the medieval guilds, a kind of cognitive syndicalism.

In addition to these two attributes, namely that knowledge increases, so that it is hard to keep up with, and to the fact that it is in specialized

hands and not in man, there is one other feature about human learning to which I should turn. It is not new; and yet our understanding of its depth and omnipresence may be a little new. It is this: knowledge, understanding, even perception, involve the knower in a choice, an action, an exclusion. We have always known this. We know that education is a pre-condition for any kind of civilization; we know that history has made us; we know that it is responsible for what we can and cannot see, and that it is remaking us now individually and as a human society. But I have a more concrete and general trait in mind. It comes from the study of cognition. It is illustrated by some experiments of the French physiologist Rostand, who studied the impulses in the auditory nerves of dogs. When he rang a bell he found an electric current along these nerves, and if he rang the bell again he found the same current; but if he put a piece of meat in front of the dog, and rang the bell, he did not get the signal. The dog's sense organs have been instructed by efferent nerves running along, and almost invisible among the great afferent sensory nerves, by a coding system, not to respond, because the dog was out to lunch.

This example, for one thing, puts the British empiricists, with their fundamental sense datum, in place. The sense datum is a most complex artifact, in some ways much more complicated than what a mathematician talks about. But it also illustrates that in order for us to see or hear, in order for us to perceive or talk or communicate, we have to ignore. In order for us to understand anything, we have to fail to perceive a great deal that is there. Knowledge is always purchased at the expense of what might have been seen and learned but was not. In all these matters the potential is enormously greater than what is really known; in terms of human knowledge the potential must transcend the real. This means that it is a condition of knowledge that we know a relatively small part of what is knowable. It is a condition of knowledge that somehow or other we pick the clues which give us insight into what we are to find out about the world. It is surely one of the great roles of the arts that they profoundly extend what and how people can see and perceive, and almost give new power to the organs of sense, and above all that they alter and extend what people can see, not only as individuals, but, even more, as a community, collectively, in common vision.

These three things, rapid growth, fragmentation, and the essentially infinite character of the knowable, characterize the cognitive house in which we now live. It seems to me clear, and historians of science and of ideas may often agree, that great discoveries in science, whatever they do for man's machines and man's mode of life, affect his thinking, not inherently because of what the ideas are, but almost by accident, for reasons that are essentially beyond human prediction: some sense of analogy between the scientific idea and a human or a political hope, some haunting word or image or reinforcement for what the mood of

a society is, what men feel their future and their destiny to be. What we learn in science itself also has a great deal that is accidental, perhaps the beginnings more than the ends; but I speak of a much wider, more pervasive decoherence. I take a very loose, undoctinaire view of the cognitive relation of what is learned in the sciences, and what the great ideas of a time are, the ways in which people organize and order their experience of life as a whole. I do not think that philosophy is grown from science, though it may be nourished by it, even philosophy in the unacademic, common sense of the word.

It must be clear then that one reason for an anxiety with regard to the firmness of tradition, one reason why we cannot help being somewhat anxious about the stability of values, derives just from the rapidity with which knowledge changes, and from the exclusion of individual men from any adequate sense of what it is. Values clearly mean a commitment to the future, what one will stand for, what one will do, what one cannot do, where one will not be. They involve an appreciation of the past, without which it is even hard to define what one could mean by such a word. Perhaps generally speaking, aesthetic values rest more heavily on an appreciation of the past, and ethical values on a commitment to the future; but if knowledge changes every few years, arching structures like values, which unite the past and the future through the present, will be put to it to retain their content, retain their factual practical meaning. It is easy to say that we believe in virtue; it is easy to say that there is a great deal of evil in the world; but it is not so easy to know in terms of common concrete experience in this changing scenery, all that these words should mean.

For this is a time when the specialized traditions flourish and the common one, binding all of us together, is eroded. It is eroded very much by the fact that the terms in which problems come to us are not familiar. It is eroded by the changing institutions and forms of our society, by the fact that the explosion in knowledge is coupled to and accompanied by an explosion in technology and by rapid change in every aspect of the way men live. I see with great misgivings the fact that faced, for instance, with the questions posed by the rapid development of superweapons, the resources of our traditional attitudes toward good and evil are hardly available. They seem hardly to bear on this problem, which nevertheless may involve the end or the survival of the human race, and which most certainly should not be taken out of the framework of man's ethical life.

These practical problems are one part of change; the other is the extraordinary change in the intellectual background of life, in the knowledge we have about nature, about man, in the increases which are now threatened and promised, but will, within the century, if we have some peace, entirely overshadow what we can now imagine as to the properties of living organisms and the characteristics of man himself.

One could, hearing of the consequences of change, ask whether it might not be a good idea to stop it. I do not think so: I think that the immense utility of knowledge, man's cupidity and curiosity, his sense of adventure, will probably put it wholly outside the probabilities of history that the quest for knowledge stop or that the success of the quest be impaired. I think that only religious or political tyranny, of a very total character, is likely to do that. It did happen when the Muslim Renaissance was extinguished; we live today with some of the consequent troubles. Yet that was a very different world. For myself, I think that the commitment to knowledge is so inherently a part of the human condition, and so inherently a human virtue, that one will not exorcise it, and yet leave man intact. It is not, I think, as some scientists have urged, the unique central principle for the organization of society; but it is a central part of human life.

It is of course true that the very growth of our knowledge has posed many kinds of practical problems. I hesitate to go into them. I have an enormous sense of inadequacy to it. I may mention two kinds. I have spoken of the troubles of communication, of the troubles of common understanding. From this I think it follows that you do not compound the troubles in any way that can be avoided. Thus I am disturbed, for instance, more than I otherwise would be, by habits which clutter, impede, or frustrate communication. What are they? What do I have in mind? For one thing, any source of information which has a monopoly of it, as a government often may, can be dogmatic. It can give so monolithic a view of what is going on, it can so oversimplify what it is doing, what the state of affairs is, that people cannot really learn the truth. Where we most manifestly do this, and perhaps with the best reasons, and the best conscience, is when we are deeply engaged in a great war. Yet when I think of the two world wars of the century, I am not convinced that we have thus done any great service for ourselves, for our cause, for our country or for peace by so grossly simplifying everything. For the evil of such dogmatism is not only that it limits the capacity of ordinary folk to understand something of the true complexity and the true variety of things; it does this also for the very functionaries of the government who have brought it about.

Secrecy is a terrible inhibition, obviously, to communication. This is the real agony about which technical people have been crying out: not so much that they could not do physics or biology; but that in a society dying of lack of communication, to do anything to make this disease worse was a very serious step to take, and should be taken only in the most grave and limited way.

Philistinism is a terrible trouble. One does not have to be a government to be philistine, philistine in believing that only those things which it requires no trouble to understand are important, that if something is complicated then it cannot be very important, that if something

is recondite it cannot be very important, that if something is learned, it cannot be very important. This is an easy view in a time when we know that we are unable to catch up with more than a minute fraction of the wonderful things that it is our duty, our privilege, to a certain extent our responsibility, to learn about. It is very very nice to be able to say, "That is too complicated for me; and that cannot really go very deep"; it is very tempting to find reasons for closing our eyes and ears to things and saying, "No, no, this cannot be the reality; the reality must be easier." We need, I think, to fight against that in the air, in the climate, in our whole lives, to insist that what is difficult, what is recondite, what is obscure, what is specialized, is a great part of the human treasure; we must encourage people to learn it and not to leave it aside.

Another obvious practical point is that the goal of education, in a cognitive world as eclectic, as ignorant, as accidental, as disorganized as ours inevitably will be, needs very much to be rethought. We need, certainly in higher education, to be sure that some genuine experience of discovery and rediscovery is a part of the life of everyone who is educated; we need to be sure that some genuine appreciation of the gulf which separates knowledge and ignorance is also a part of it. I say this because only people who have been through these experiences are intellectually prepared to live in a world in which they are surrounded by knowledge of which they will largely remain ignorant, prepared not to take the vulgar and superficial account of knowledge for the reality.

These problems are not easy; these are not even in a sketch very easy; and they certainly provide no curriculum, neither a political program nor an educational curriculum. But I think in the end it is where we ourselves stand, and how we live in this, that may be the hardest.

In this vast world, with its unceasing change, its great novelty without precedent, not easy to grasp, its great alterations, its great nostalgia for a time when things were simple, more familiar, and easier to keep in place, there are yet present for us beautiful and growing perspectives of understanding and order, more than ever really in man's whole history. The great sciences offer in a most moving way an example of this harmonization, on the one hand of change and novelty and disorder, and on the other a great and overriding sense of harmony and order.

We have, I think, in dealing with this world, a double duty; a duty on the one hand to be constant and firm and faithful to what we really know, to what is close to us, to our art, our knowledge, our own community, our tradition, in the sense in which tradition has been the story of man's glory, where we live fully as men. To all the other traditions, to all the rest of the world with its wonders that we do not know very well, we need a sense of hospitality and openness, a willingness to make room for the strange, for the thing that does not fit. This is a hard double duty. If it is made possible at all, it is because it is moderated by things quite outside the cognitive order; by friendship, by the regard and love

we bear one another, which soften the harshness of isolation, which bring us news and sympathy and understanding of what our fellows are doing, which bind a common human tie between us, and between the many, many branches of this growing tree of knowledge. These two parts of our duty make a picture of a common life and an ordered world very different from any that man has ever been content to accept, not very easy, not very tranquil, but with a hope of a common life touched and illuminated by community, and by knowledge of the world and of man.

FORTY-FIRST ACLS ANNUAL MEETING

The next Annual Meeting of the ACLS will be held in New York on January 21-22, 1960. The hotel headquarters are to be the Sheraton-Atlantic (formerly the Sheraton-McAlpin).

The first day's sessions are planned around the theme of "The Bible and the Humanities." Four distinguished scholars will present papers:

"The Bible and Ancient Civilizations," Erwin Goodenough (Yale University)

"The Bible in Catholicism and Protestantism," Roland Bainton (Yale University)

"Biblical Criticism and Its Effect on Modern Civilization," Mortin Enslin (St. Lawrence University)

"The Bible from a Literary Point of View," Howard Mumford Jones (Harvard University)

Each of these papers is to be followed by discussion from the floor. The audience will be limited to members of the Council, secretaries of the constituent societies, and invited guests.

The ACLS Annual Lecture will take place at the Metropolitan Museum of Art on Thursday evening, January 21. The topic is to be "The Bible and Archaeology." The speaker, Nelson Glueck, is President of the Hebrew Union College—Jewish Theological Institute of Religion, Cincinnati, New York, and Los Angeles. Professor Glueck has participated in a number of archaeological excavations in Eastern Palestine (1934, 1935, 1939, 1951) and is the author of a number of books including *The Other Side of the Jordan* (1940), *The River Jordan* (1946), and, most recently, *Rivers in the Desert* (1959). The Annual Lecture is open to the public.

The closed business meeting of the Council will be held on Friday morning, January 22.

Participants in the Annual Meeting will have an opportunity to visit a special exhibition at the Pierpont Morgan Library, related to this year's theme. Open to the public from December 15, 1959 through February 27, 1960, the exhibition will include early papyri, illuminated manuscripts, and the first printed editions of Bibles in a number of languages.



